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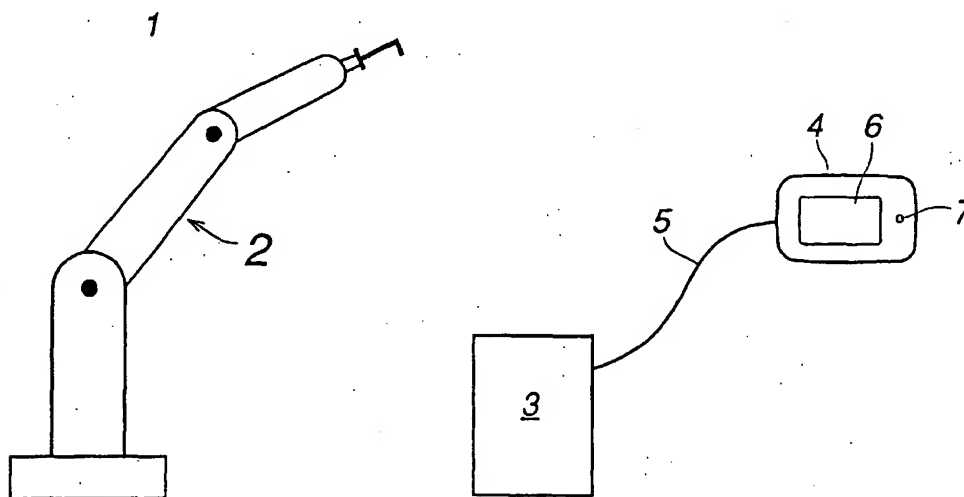
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(54) Title: **INDUSTRIAL ROBOT SYSTEM COMPRISING A PROGRAMMABLE UNIT**



(57) Abstract: The invention concerns a robot system comprising an industrial robot provided with a control system and an arrangement for programming of the robot. The arrangement comprises a data processing unit, a screen connected to the data-processing unit and an application program to program the robot. The programmable and controllable unit, the TPU, is portable and arranged with a grip surface for the gripping hand of an operator.

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Industrial robot system comprising a programmable unit

TECHNICAL FIELD

5 The invention relates to an industrial robot system comprising at least one industrial robot and a portable unit connected to the robot system for programming and operation of the movements of a robot:

10 BACKGROUND ART

An industrial robot system comprises at least one industrial robot with a manipulator, a control system and a programming and control unit for programming the movements
15 of the robot. The programming and control unit is portable and is designated TPU, Teach Pendant Unit, in the following. A TPU usually comprises function controls, a joystick and a display screen.

20 From the document US 5 790 401, a TPU is previously known which comprises an input unit in the form of a touch screen as well as a joystick. The object of the TPU is to combine the possibilities of control of the robot via a joystick and control via a touch screen.

25 The document US 6 134 102 shows a TPU with an ergonomically designed outer casing intended to allow an operator to grip it in various convenient ways. Either the operator holds the TPU with both his hands or with his left hand only.
30 Throughout, the object is to hold the TPU with one's left hand and to operate the other function keys and the joystick with one's right hand. Alternatively, the TPU is designed to stand on a base. The known TPU does not permit left-handed operation. If the operator wants to hold the
35 TPU in his right hand and operate the function key with his left hand, a version of a TPU adapted for left-handed persons must also be manufactured.

When programming the movements of a robot, different operators operate at different times with the same TPU. Some of the operators are right-handed and others are left-handed. In addition, there are operators who alternately use their right and left hands. There are several reasons therefor. One example is in order to reduce the static load that arises when a right-handed operator holds the TPU too long with his right hand or the corresponding case for a left-handed operator. Another example is when the space around a robot is such that one hand is preferable to the other in certain positions during programming and operation. Thus, the need of a TPU arises which is designed so as to allow operation by either the left or the right hand. This need comprises the possibility that the operator, during the course of the work, moves the TPU from one hand to the other and hence works alternately with his right and his left hand, respectively. In addition, there is a need of a TPU with improved ergonomics that reduces the static loads that arise during work with a portable TPU and hence makes possible longer working periods with the TPU.

The phenomenon of operating an industrial robot via a TPU is surrounded by rules and regulations for maintaining the necessary safety and avoiding accidents involving both people and material. For example, there are regulations that the TPU shall comprise a so-called enabling device that gives the operator access to the robot. An enabling device corresponds to the previous designation "dead man's handle", that is, the enabling device requires an active and continuous action by the operator to allow access to the robot. By having access to the robot via an enabling device, the operator must operate the robot with a limited speed, which normally amounts to about 250 mm/s.

Furthermore, there is a regulation to the effect that "the key that starts the movement of a robot should also stop it". That regulation applies, inter alia, if the operator operates the robot at full speed manually via the TPU, that

is, when the robot moves at the speed prescribed by the program. The safety philosophy behind the current regulation thus implies that a TPU shall be provided with an enabling device and a function control that, activated
5 simultaneously, give the operator access to operate a robot at full speed in accordance with the current program. The latter function control is designated HTR (hold-to-run) button in the following. When an operator is to operate a robot at full speed, it is thus required that the operator
10 continuously activates an HTR button to be granted access to operate at full speed and holds it activated as long as the robot is being operated at a high speed.

A TPU is often provided with a display screen. Either the
15 display screen has the function of a touch screen or the TPU comprises a keyboard. Irrespective of the design, this imposes further requirements on the operator who should manage to hold the TPU, to activate a number of function controls and at the same time with one finger, part of his
20 hand, or some other touch tool, program and operate the movements of the robot. The work becomes both physically and mentally strenuous for the operator when his hands do not cope with everything that has to be done simultaneously. The work is made more difficult by the fact that
25 the operator is subjected to static loads in his hands, arms, shoulders and neck since the work with the TPU is time-consuming and not flexible. This creates a need of a TPU with improved ergonomics that makes possible a more comfortable grip for the hand of the operator when a number
30 of function controls are to be activated simultaneously.

A TPU is connected to a control system either via a cable or via wireless communication. When it is connected by means of a cable, an ample length of cable is required to
35 give an operator the necessary freedom to move around with the TPU. This means that the cable will partly be positioned on the floor, with an ensuing risk that a passing vehicle will run over and damage the cable. A damaged cable

leads to a shut-down and the activity stops until the damage has been attended to. The problem is that if this occurs relatively frequently, it entails unwanted losses of time and extra costs.

5

It is realized from the above description that there is a need for a robot operator to manage to grip a TPU such that the work with the TPU becomes comfortable, ergonomically correct and that the picture on the display screen is oriented so as to be legible to the operator. In addition, an operator shall both activate certain function controls and carry out the necessary touch movements or press the necessary buttons for the programming and control of the robot according to the above. Taken together, this leads to a need of a TPU which, in a comfortable way, makes possible, facilitates and simplifies the work for the operator and which, in addition thereto, fulfils the current safety regulations. In addition, the cable connected to the TPU should be arranged so as to reduce the risk of damage.

20

The TPUs available on the market today have the disadvantage of requiring a precise grip on the enabling device in order for the operator to have access to the robot. In a previously known mechanical double-channel solution involving two buttons, it is required that the operator should press both buttons simultaneously to be granted access to a robot. Problems arise when the operator omits to press both buttons or presses the buttons with a certain delay in time, resulting in the two signals being displaced in phase. A TPU is programmed to accept a certain phase displacement, and in the two mentioned situations the phase displacement of the signals often becomes too great. This results in denied access to the robot. The operator has to start again from the beginning and grip the enabling device with better precision. Sometimes, the operator has to start all over again several times before access is granted, which makes the work time-consuming and the operation of the robot expensive. In addition, it creates a source of

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irritation to the operator. This results in a need of a TPU provided with an enabling device that is simple to grip and that permits access to the robot without requiring precision of the grip.

5

Another disadvantage of known TPUs is that they are adapted to be gripped by a hand of normal size, which implies that persons with comparatively large or small hands find it more difficult to handle the TPU. This calls for a programming unit, TPU, which is ergonomically designed, which
10 suits both right- and left-handed persons and which facilitates and makes more efficient the work of the operator.

SUMMARY OF THE INVENTION

15

The object of the present invention is to facilitate the work of an operator to work with a TPU, defined according to the above, when handling an industrial robot. The object is thus to arrange an industrial robot system with a portable TPU, which permits the operator to work in a flexible,
20 efficient and comfortable manner whether he is right-handed or left-handed. The object comprises arranging the TPU with respect to improved ergonomics to make possible and facilitate longer working periods at the TPU.

25

According to the invention, the above-mentioned object is achieved with an industrial robot that exhibits the characteristic features described in the characterizing portion of claim 1. The solution according to the invention is to
30 arrange an industrial robot system comprising an industrial robot that includes a manipulator, a control system and a portable programming and control unit, TPU, connected to the control system for programming and operating the robot. The TPU according to the invention is enclosed and provided
35 with a handle comprising a gripping surface for the gripping hand of an operator. The TPU is adapted to adopt a first operating position A for a right hand, in which position the robot is operated with the left hand and is adap-

ted to adopt a second operating position B for a left hand, in which the robot is operated with the right hand. The gripping surface is arranged symmetrically around a longitudinal line C to allow comfortable gripping by either the right or the left hand. This makes the TPU operable with either the right or the left hand. The TPU is thus operable with either the left or the right hand in the respective operating positions.

10 The inventive concept comprises arranging the industrial robot system according to the invention in accordance with the dependent claims 2-5. Thus, the inventive concept comprises arranging the TPU with a display screen and a first function control to orient a picture on the display screen
15 legible to the operator. By activating the first function control, it is possible to orient the picture so as to be legible to the operator. In an advantageous embodiment of the invention, the TPU is connected via a red cable to the control system.

20 In an advantageous embodiment of the invention, a second and a third function control are arranged within the gripping area of a hand in operating position A or B. The gripping surface and the second function control are arranged
25 on the TPU to make it possible for an operator to carry the unit with one hand while at the same time activating the second function control with the same hand. This gives the operator a second hand free for handling of the other function controls.

30 The inventive concept comprises a portable programming and control unit, TPU, in accordance with the independent claim 6. Thus, the inventive concept includes a TPU for programming and operating an industrial robot including a manipulator and a control system. The TPU according to the invention
35 is enclosed and provided with a handle comprising a gripping surface for the gripping hand of an operator, a display screen adapted to show a picture, and a plurality

of function controls. The gripping surface is adapted to be graspable with either the right or the left hand. The TPU is adapted to adopt a first operating position A for a right hand, which position permits the robot to be operable with the left hand. The TPU is adapted to adopt a second operating position B for a left hand, which position permits the robot to be operable with the right hand. The display screen is visible for the operator in both operating positions. A first function control is provided with the function of orienting the picture on the display screen in order to be legible to the operator. In one embodiment, a second function control is provided with the function of an enabling device.

15 In one advantageous embodiment, the enabling device is arranged integrated into the gripping surface. The gripping surface consists at least partly of a layer of a flexible material in the form of an elastic diaphragm-like layer, which covers the enabling device. The elastic layer covers the gripping surface, where the gripping surface has an extent larger than a comparatively large hand. This means that the enabling device and the gripping surface, respectively, suit and are large enough for all sizes of hands, irrespective of whether the operator is right-handed or left-handed. The operator's hand rests against the elastic layer made of, for example, rubber. The hand activates the enabling device while at the same time gripping and holding the TPU. The TPU according to the invention has the advantage of allowing a gripping hand to activate the enabling device irrespective of where on the enabling device the grip is being made. This entails the possibility of the enabling device being activated even if the hand grips somewhat obliquely.

35 In one advantageous embodiment, the enabling device comprises a multi-channel contact with a yoke and at least two circuit breakers arranged in spaced relationship to each other. The yoke is bow-shaped and adapted to influence all

the circuit breakers. It is part of the inventive concept that the operator, by touching/loading the yoke at one point only, activates all the circuit breakers. The enabling device according to the invention hence makes it possible for an operator to press at an arbitrary point on the enabling device and still activate the yoke and thereby all the circuit breakers. This gives the operator access to a robot irrespective of the position and the size of the hand. This gives the operator a possibility, in a convenient and rapid manner, of gripping the inventive TPU with one hand and finding a comfortable working position for his hand.

It is part of the inventive concept that the TPU comprises a third function control provided with a hold-to-run function, an HTR button. In one advantageous embodiment, the HTR button is arranged within the gripping area of the gripping hand. In another embodiment, the TPU is provided with two HTR buttons, one within the gripping area of a gripping right hand and one within the gripping area of a gripping left hand. In a further advantageous embodiment, the HTR button is arranged within reach of the thumb on the gripping hand. A TPU according to the invention has an ergonomically designed gripping surface and an ergonomically correct location of the function control. An operator has the possibility of gripping the TPU and activating the function control with one hand without having to stretch, tighten or stress his hand. This makes it possible for the operator to work during comparatively longer working periods using a TPU according to the invention.

The inventive concept comprises arranging the TPU with at least one emergency stop. In an advantageous embodiment of the invention, two function controls with an emergency stop function are arranged symmetrically/diagonally on the TPU.

The inventive concept comprises connecting the TPU via a cable to the control system. In an advantageous embodiment of the invention, the cable is painted red.

- 5 The inventive concept comprises a method in an industrial robot system in accordance with the independent claim 33. The industrial robot system comprising an industrial robot including a manipulator, a control system and a portable TPU connected to the control system for programming and
- 10 operating the robot. The programming unit comprises a display screen adapted to show a picture to an operator as well as at least one function control. The method is characterized in that the unit is moved from a first operating position A for a right hand to a second operating position
- 15 B in a left hand. The picture on the display screen is brought to be oriented so as to be legible to the operator by the operator activating a first function control.

Hence, the inventive concept comprises a method in which

20 the TPU is moved from a right/left hand to a left/right hand. During the movement, the programming unit is rotated through 180 degrees with the display screen being all the time visible to the operator. Further, the picture on the display screen is brought to be rotated through 180 degrees

25 by the operator activating a first function control.

The inventive concept comprises methods in accordance with the dependent claims 34-36. Thus, the inventive concept comprises arranging the TPU such that an operator, by grip-

30 ping the programming unit with his right or left hand on the gripping surface, thus holds and carries the TPU. It is also part of the inventive concept that the operator, by the above-mentioned grip, holds and carries the unit as well as activates an enabling device, integrated into at

35 least part of the gripping surface, with one hand. The inventive concept also comprises the operator holding and carrying the unit, activating an enabling device and, in

addition, activating the function control with the hold-to-run function with the same hand.

The inventive concept according to the invention comprises
5 use of an industrial robot system, a portable device for programming and operating an industrial robot, and a method in an industrial robot system for wireless connection to an optional industrial robot in accordance with the independent claim 37.

10

The inventive concept comprises all industrial robots that comprise a control system to which a programming and control unit including a display screen is connected, with or without connection to a data-processing unit with operable
15 application programs for the robot.

This description of the invention is not to be regarded as a limitation of the invention but only as a guidance for a full understanding of the invention. Adaptations to robot
20 cells with other active parts included and replacement of parts and features that are self-evident for a person skilled in the art are, of course, included in the inventive concept.

25 BRIEF DESCRIPTION OF THE DRAWING

The invention will be explained in greater detail by description of embodiments with reference to the accompanying drawing, wherein

30

Figures 1a and 1b show a programmable unit according to the invention, provided with two different function controls, Figure 1c shows the unit according to Figures 1a and 1b, viewed from below with a symmetry axis C inserted into the
35 figure,

Figures 2a-2c shows a function control according to the invention, comprising a multi-channel contact,

- Figure 3 shows a programmable unit according to the invention with three different function controls,
Figure 4 shows a programmable unit according to the invention, provided with an emergency stop,
5 Figure 5 shows a programmable unit according to the invention, gripped with a right hand,
Figure 6 shows a programmable unit according to the invention, gripped with a left hand,
Figure 7 shows a programmable unit according to the invention,
10 Figure 8 shows a programmable unit according to the invention, equipped with a red cable for connection to the robot system,
Figure 9 shows a programmable unit according to the invention, connected via wireless connection to the robot system,
15 Figures 9a-d show how a programmable unit according to the invention is moved while being rotated half a turn from a right hand to a left hand,
Figure 10 shows an industrial robot system with a robot wherein a programmable unit according to the invention is
20 connected to the system via a cable.

DESCRIPTION OF THE PREFERRED EMBODIMENT

- The invention relates to an industrial robot system and the invention is exemplified in Figure 10 by an industrial
25 robot 1 comprising a manipulator 2 with a control system 3. A portable programming and control unit, TPU, 4 is connected to the control system 3 by a cable 5. The programming unit is schematically shown with a display screen and a
30 function control 7.

- Figures 1a and 1b show a TPU according to the invention provided with a first function control 7a. The TPU is enclosed and has a handle comprising a gripping surface 8.
35 Further, the TPU is provided with a display screen 6 and a second function control 7b. The first function control 7a has the function of orienting the picture by rotating the picture 10 on the display screen through 180 degrees. The

second function control 7b has the function of an enabling device 11. The handle comprising the gripping surface 8 is shaped to allow the TPU to be gripped with a right hand 9a or a left hand 9b and is carried resting against the lower arm (schematically shown in Figures 5 and 6) belonging to the gripping hand. Figure 1c shows that the handle with the gripping surface is arranged symmetrically in relation to a longitudinal symmetry line C and permits similar handles fitting either the right hand or the left hand.

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Figures 2a-c show a schematic embodiment of an enabling device 11 according to the invention. The enabling device 11 is here integrated into the gripping surface 8. An operator, gripping and holding the TPU, at the same time activates the enabling device 11 and is thus given access to the robot. The enabling device 11 comprises a multi-channel contact and in the present embodiment it includes a yoke 14 and two circuit breakers 15 arranged in spaced relationship to each other. The yoke 14 has an extent such as to influence both circuit breakers. The enabling device 11 is arranged below the gripping surface 8, which in the present embodiment consists of a layer of a flexible material in the form of an elastic diaphragm 12. When a hand grips the TPU, the hand presses on the elastic layer and hence activates the enabling device.

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Figure 3 shows an embodiment of the invention in which a TPU is provided with a first 7a, a second 7b and a third 7c function control. The three function controls are arranged on the TPU in such a way that an operator with a right hand 9a or a left hand 9b manages to carry the TPU and to activate the second 7b and the third 7c function control at the same time. In the present embodiment, the third function control 7c is placed on the TPU within the gripping area of the gripping hand.

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Figure 4 shows an embodiment of a TPU 4 according to the invention, in which two function controls 7d, with the

function of acting as an emergency stop, are symmetrically/diagonally placed on the TPU.

5 Figure 5 shows an embodiment of a TPU according to the invention, gripped by a right hand 9a. The TPU is in a first operating position A and the gripping right hand 9a activates the second function control 7b while at the same time the hand activates a third function control 7c with the thumb 16.

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Figure 6 shows an embodiment of a TPU according to the invention, gripped by a left hand 9b. The TPU is in a second operating position B and the gripping hand 9b activates a second function control 7b while at the same time the hand
15 activates a third function control 7c with the thumb 16.

Figure 7 shows an embodiment of a TPU according to the invention, which is connected to a control system 3. Figure 8 shows a TPU corresponding to that of Figure 6, which is
20 connected by wireless connection to a control system 3.

Figures 9a-d illustrate step-by-step the method, according to the invention, of rotating/turning a TPU when moving the TPU from a first operating position A in a right hand 9a to
25 a second operating position B in a left hand 9b and thereafter orienting the picture 10 on the display screen 6 of the TPU by activating a first function control 7a on the TPU, whereby the picture is turned 180 degrees.

30

CLAIMS

1. An industrial robot system comprising a industrial robot (1) including a manipulator (2), a control system (3) and a portable programming and control unit, TPU, (4) connected to the control system for programming and operating the robot, the TPU (4) being enclosed and provided with a handle comprising a gripping surface (8) for the gripping hand (9) of an operator, characterized in that the TPU (4) is adapted to adopt a first operating position (A) for a gripping right hand (9a), in which position the robot is operated with the left hand (9b), the TPU (4) is arranged in a second operating position (B) for a gripping left hand (9b), in which position the robot is operated with the right hand (9a), and that the gripping surface (8) is arranged symmetrically around a longitudinal line (C) to allow gripping by either the right (9a) or the left (9b) hand.
2. An industrial robot system according to claim 1, wherein a first function control (7a) is adapted to orient a picture (10), on a display screen (6) arranged on the TPU, so as to be legible to an operator.
3. An industrial robot system according to claim 1 or 2, wherein a second function control (7b) and a third function control (7c) are arranged within the gripping area of a hand in operating position (A) or (B).
4. An industrial robot system according to any of the preceding claims, wherein the programming unit (4) is connected via a cable (5) to the control system (3).
5. An industrial robot system according to claim 4, where the envelope surface (17) of the cable (5) is painted red.
6. A portable programming and control unit, TPU, (4) for programming and operating an industrial robot including a

manipulator (2) and a control system (3), said TPU (4) being enclosed and provided with a handle comprising a gripping surface (8) for the gripping hand (9) of an operator, a display screen (6) adapted to show a picture (10), and a plurality of function controls (7), characterized in that the gripping surface (8) is arranged symmetrically around a longitudinal line (C) to allow gripping by either a right (9a) or a left (9b) hand, the TPU (4) is adapted to adopt a first operating position (A) for a right hand (9a) and a second operating position (B) for a left hand (9b), the display screen (6) being visible to the operator in both positions, and that a first function control (7a) is provided with the function of orienting the picture (10) on the display screen (6) so as to be legible to the operator.

7. A programming unit according to claim 6, wherein a second function control (7b) is provided with the function of an enabling device (11).

8. A programming unit according to any of claims 6-7, wherein the gripping surface (8) and the second function control (7b) are arranged on the unit (4) to make it possible for an operator to carry the unit (4) and at the same time activate the second function control (7b) with the same left hand (9b)/right hand (9a).

9. A programming unit according to any of claims 7-8, wherein the second function control (7b) is adapted to be integrated into the gripping surface (8).

10. A programming unit according to any of claims 6-9, wherein the gripping surface (8) at least partly consists of a layer of a flexible material in the form of an elastic diaphragm (12).

11. A programming unit according to claim 10, wherein the second function control (7b) is adapted to be covered by the elastic diaphragm (12).

5 12. A programming unit according to any of claims 6-11, wherein the gripping surface (8) is designed to fit both a left hand (9a) and a right hand (9a).

10 13. A programming unit according to any of claims 6-12, wherein the second function control (7b) comprises a multi-channel contact (13) that is provided with a yoke (14) and at least two circuit breakers (15), where the circuit breakers are arranged in spaced relationship to each other and where the yoke (14) is adapted to influence all the circuit
15 breakers (15).

14. A programming unit according to any of claims 6-13, wherein at least a third function control (7c) is provided with a hold-to-run function.

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15. A programming unit according to claim 14, wherein the third function control (7c) is arranged within reach of a gripping hand (9a, 9b) in a gripping position on the gripping surface (8).

25

16. A programming unit according to any of claims 14-15, wherein a third function control (7c) is arranged on the programming unit (4) within the gripping area of a right hand (9a) and an additional third function control (7c)
30 arranged within the gripping area of a left hand (9b).

17. A programming unit according to any of claims 14-16, wherein the third function control (7c) is arranged within reach of the thumb (16) of the operator's gripping hand.

35

18. A programming unit according to any of claims 6-17, wherein at least one function control (7d) with an emer-

gency stop function is arranged on the programming unit (4).

19. A programming unit according to claim 18, wherein a first (7d) and a second (7d) function control with an emergency stop function are arranged symmetrically/-diagonally on the TPU (4).

20. A programming unit according to any of claims 6-19, wherein the TPU is connected via wireless connection to the control system (3).

21. A programming unit according to any of claims 6-20, wherein the TPU is connected via a cable (5) to the control system (3).

22. A programming unit according to claim 21, wherein the envelope surface (17) of the cable (5) is painted red.

23. A programming unit according to any of claims 6-22, wherein the gripping surface (8) is symmetrically shaped around a longitudinal symmetry line C.

24. A method in an industrial robot system comprising an industrial robot (1) including a manipulator (2), a control system (3), and a portable programming and control unit, TPU, (4) connected to the control system for programming and operating the robot, wherein the TPU (4) comprises a display screen (6) adapted to show a picture (10) to an operator as well as at least one function control (7), characterized in that the TPU (4) is brought to adopt a first operating position (A) gripped by a right hand (9a), in which the robot is operated with a left hand, the TPU (4) is brought to adopt a second operating position (B) gripped by a left hand (9a), in which the robot is operated with a right hand, and that

the picture (10) on the display screen (6) is brought into an orientation legible to the operator.

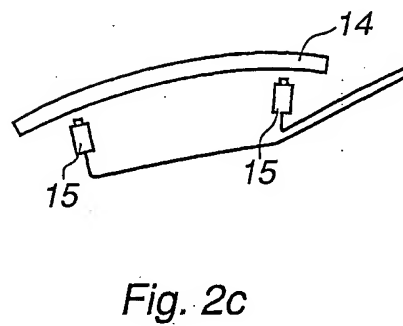
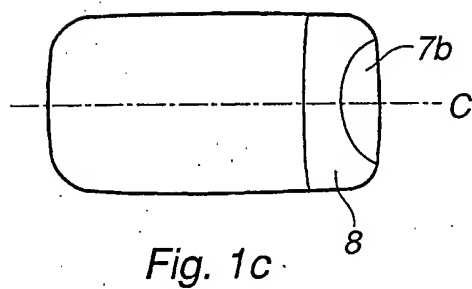
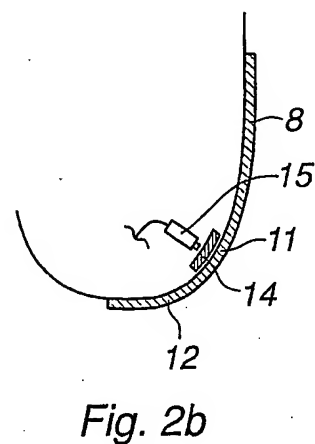
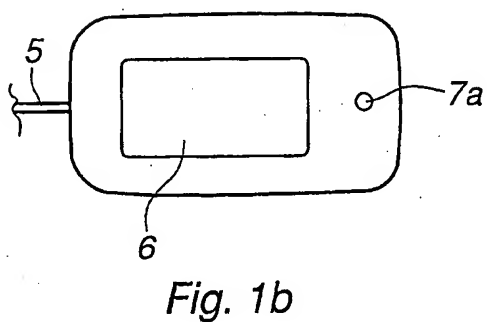
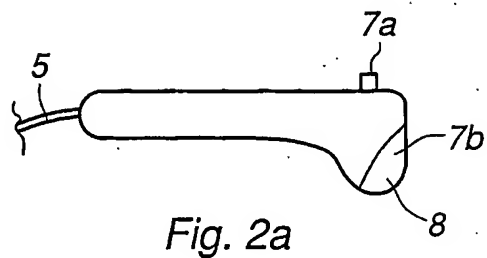
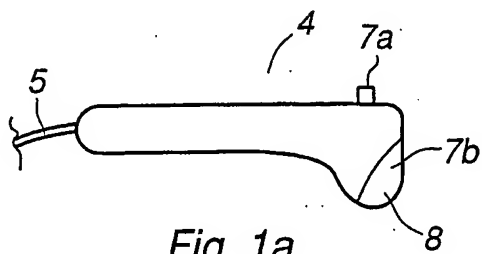
25. A method according to claim 24, wherein the operator,
5 by gripping the programming unit (4) with his right hand (9a)/left hand (9b) on the gripping surface (8), holds and carries the unit (4).

26. A method according to claim 25, wherein the operator
10 both carries the unit (4) and activates a second function control (7b) with the same hand (9a, 9b).

27. A method according to claim 24, wherein the operator
15 carries the unit (4), activates a second function control (7b) and, in addition, activates a function control (7c) with a hold-to-run function with the same hand (9a, 9b).

28. Use of an industrial robot according to any of claims
20 1-3, a portable TPU for programming an industrial robot according to any of claims 6-23, and a method according to claims 24-27 for wireless connection to an optional industrial robot.

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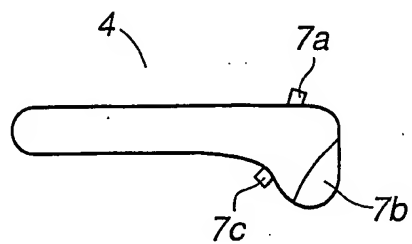


Fig. 3

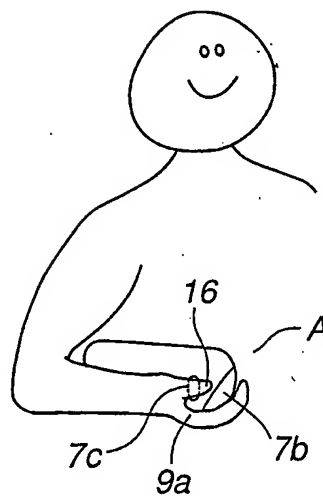


Fig. 5

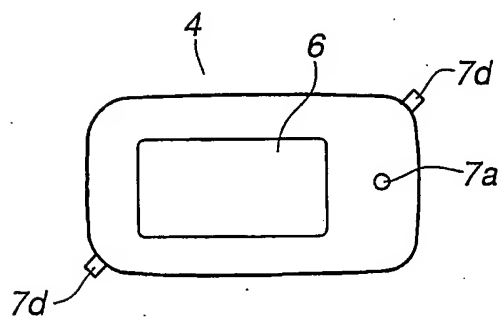


Fig. 4

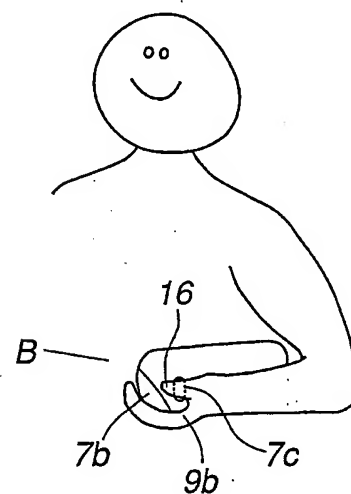


Fig. 6

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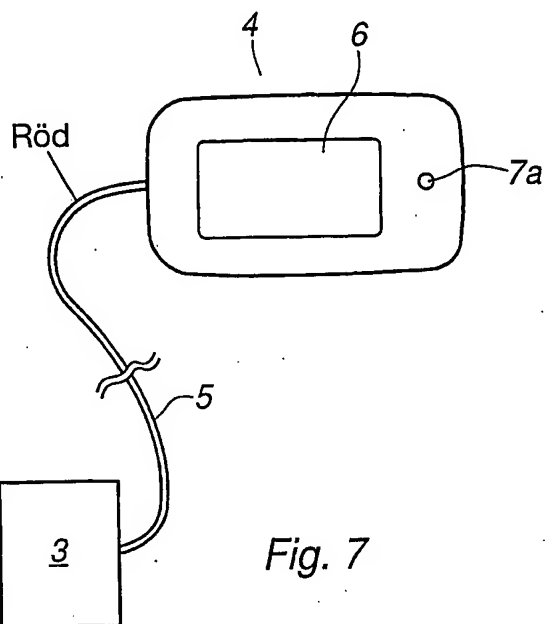


Fig. 7

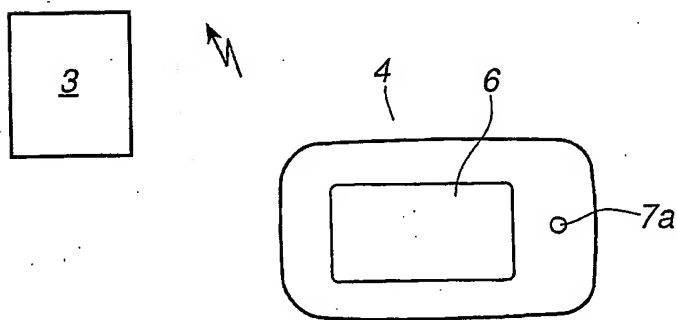


Fig. 8

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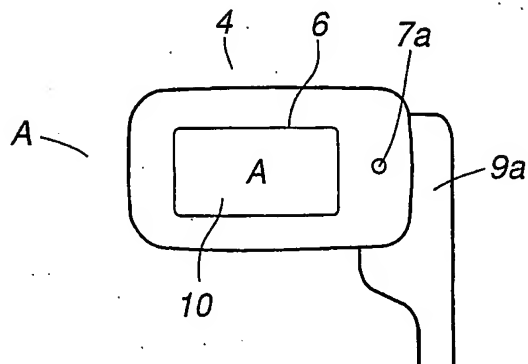


Fig. 9a

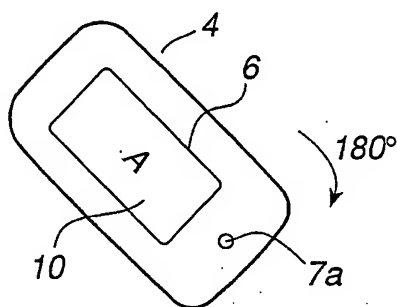


Fig. 9b

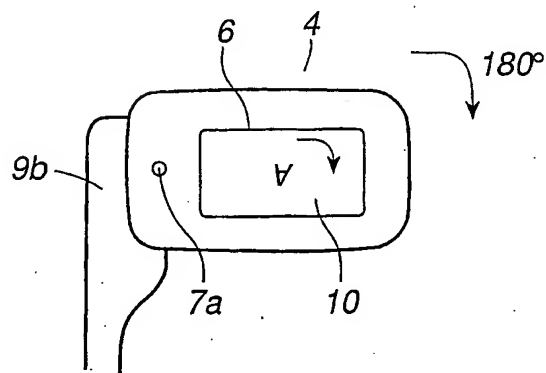


Fig. 9c

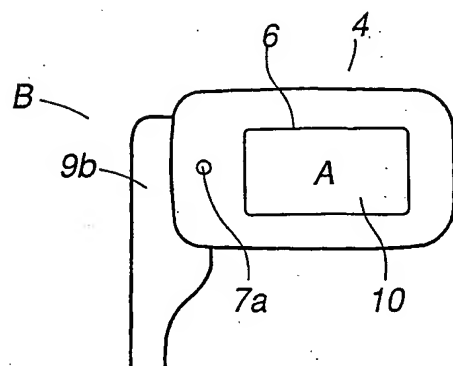


Fig. 9d

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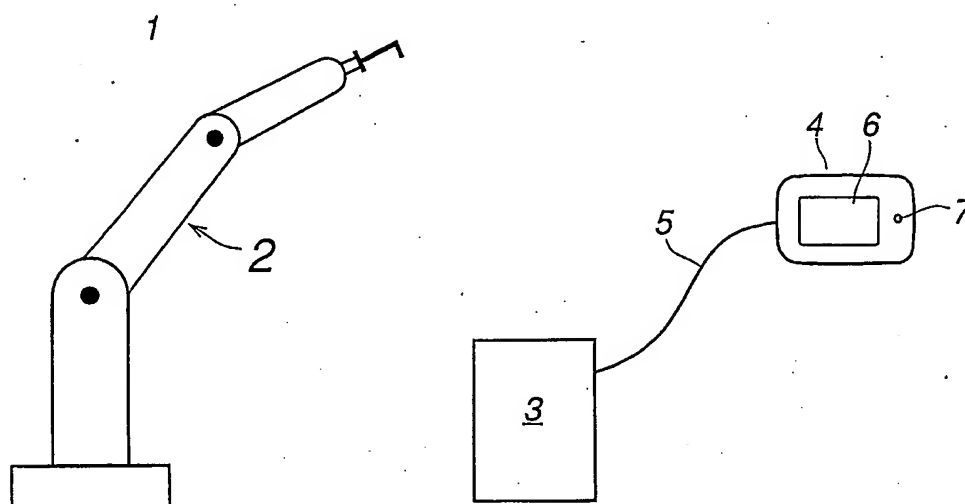


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/01772

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B25J 13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B25J, G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTENAL, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0960697 A1 (FANUC LTD MINAMITSURU-GUN), 1 December 1999 (01.12.99), column 10, line 28 - line 31, see the figures	1
Y	--	2-28
Y	DE 29723792 U1 (SIEMENS AG), 12 May 1999 (12.05.99), figures 1-3	2-28
A	DE 19630971 C1 (BRENDL, WOLFGANG), 7 May 1998 (07.05.98), abstract, see the figures	1-28

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

Date of mailing of the international search report

7 January 2003

08-01-2003

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/01772

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0333874 A1 (FANUC LTD), 27 Sept 1989 (27.09.89), abstract, see the figures --	1-28
A	EP 0310958 A1 (HITACHI, LTD), 12 April 1989 (12.04.89), abstract, see the figures -- -----	1-28

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/12/02

International application No.

PCT/SE 02/01772

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